Complex interaction of polarized light with three-dimensional opal-based photonic crystals: diffraction and transmission measurements

M. V. Rybin[1], A. V. Baryshev[1,2], M. Inoue[2], A. A. Kaplyanskii[1],
V. A. Kosobukin[1], M. F. Limonov[1], A. K. Samusev[1], and A. V. Sel'kin[1],
[1] Ioffe Physico-Technical Institute, 194021, St.Petersburg, Russia.
[2] Toyohashi University of Technology, Toyohashi, Aichi 441–8580, Japan.

We investigated the photonic bandgap structure of synthetic opals by combining optical polarization-resolved diffraction patterns and polarization- and angle-resolved transmission spectra. The diffraction patterns were observed as symmetrical sets of spots, each being a colored fingerprint of the photonic bandgap for a certain direction [1]. In transmission spectra, the measured energy positions of the deeps were found to be in a good agreement with the calculated data. We found strong anisotropy in intensity of both diffracted and transmitted light with different polarizations along special crystallographic directions. The polarization-resolved diffraction patterns and transmission spectra are discussed in terms of the two-band mixing formalism [2] for Bloch states in a photonic crystal taking into account the relative orientation of different crystallographic planes {*hkl*} in the opal structure. The conclusion has been made which bridges optical spectroscopy of photonic crystals and optical spectroscopy of conventional bulk homogeneous materials.

The support of the EC-funded projects PHOREMOST (FP6/2003/IST/2-511616) is gratefully acknowledged.

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